

III. *On the emergence of Myrmeleon formicarius from the pupa.* By W. J. LUCAS, B.A., F.E.S.

[Read December 6th, 1905.]

IN this species, striking changes take place in the structure of the mandibles as the insect passes from the larval to the imaginal stage. The object of this paper is to call attention to these changes, and especially to the modifications of the pupal mandible to fit it for cutting open the cocoon—an operation not, however, performed by the pupa (strictly speaking) but by the imago, immediately before it sheds the pupal skin. A few notes are added on the larval habits as observed by Dr. Chapman and myself. Though these probably contain nothing new, they may interest English entomologists who have few opportunities of seeing these curious larvæ.

[Notes on the larvæ made by T. A. Chapman, M.D., before they passed into my possession.—“I brought home several of these Ant-lion larvæ on Aug. 10th, 1904, having found them a week or so earlier at La Granja (Spain). They were there very abundant amongst what was rather dry dusty earth—scarcely sand—in the pine forest, where the trees were even somewhat densely placed. They were quite under the trees, most abundant in fact close to their roots, so that it may well be, that they preferred such places as being less exposed to rain. They were sometimes so abundant that a square foot was occupied by eight or ten of them of various sizes. During the six weeks I had them at home before passing them on to Mr. Lucas they ate a good many larvæ, chiefly of small Lepidoptera. If the larva was too large, they avoided it and were with difficulty got to seize it. In this they were well-advised, since the result was either that the larva jerked itself loose, or jerked the ant-lion out of the sand, into what would naturally be a position of much danger. A small larva, when once seized had no chance of escape, and after a few spasmodic twists, became passive and was soon dead. When hungry, the ant-lion sucked the larva very dry, so that a minute shred only remained, if the larva

given was a small one. When too well supplied, however, larvæ were left only half emptied. They grew considerably whilst I had them, not however moulting, but chiefly filling out after the starvation incurred through being brought here. They made typical pits several times. I saw them not infrequently throwing out sand by the backward jerk of the head. This was done either in making a pit or in repairing it. Roesel, I think, says they also did this by way of artillery, to bring an insect at the edge of the pit, down within their reach. In a broad sense I think this is true; an insect at the edge of the pit may cause some sand to fall on the ant-lion at the bottom, in cases where it does not itself first reach that position, and the ant-lion at once ejects the sand in order to make his trap perfect as soon as possible. The movement in the walls of the pit so caused would probably often precipitate to the bottom an insect that would otherwise have escaped. I several times saw sand so ejected on disturbance of the pit, but in no case was there anything like aiming the shower of sand at the insect. The eyes are so placed that the insect has probably a fair view of the field of operations; on the other hand, its artillery only commands a section of the circle, and it cannot turn itself round very quickly should the insect be on the opposite side. The larva appears always to travel backwards, and always under the sand, often, when replete, going to some depth to rest. On the surface it is not very helpful, except that it can bury itself with great rapidity; it moves to some distance under the sand very quickly.”]

Two living larvæ were passed on to me at the end of September. Judging of the food from the common and scientific names that the insect bears, I supplied them with living specimens of the red ant of the fir-woods (*Formica rufa*). They would, however, have none of these, and indeed appeared unwilling to accept anything I gave them. Possibly they do not feed during the winter; at any rate they ate little or nothing till well on into the spring of the next year. One of the two could have been none the worse for its long fast, since it produced an imago of good size about midsummer (1905). Before pupating it ate one or two caterpillars. These, when seized, struggled violently at first. The ant-lion then rapidly buried itself as mentioned in Dr. Chapman's note when, suddenly as it seemed, the caterpillar became still,

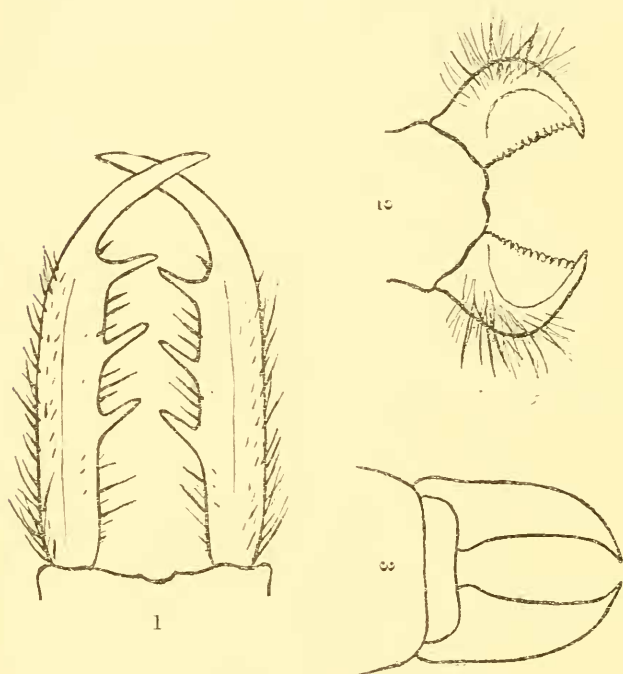
giving one the impression that it had been stung and paralysed at this juncture. Only once did I notice sand being thrown about by the larva, and even on that occasion I could not see for what purpose this was done. It should be stated that a trap was never well formed—possibly because the sand supplied was too mobile for the purpose. Often the larvæ would wander about during the night and make circular furrows in the sand, which were, there is little doubt, intended for traps. While in my possession the larvæ seemed to be usually buried well beneath the surface of the sand.

At length one day threads of a gummy nature were noticed along the sand and across the box containing the larvæ—this waste of material seeming to be ill able to be spared by so small an insect which had to produce so large an imago. Gradually there arose from the surface of the sand a spherical cocoon consisting of grains of sand cemented together by this gummy material (liquid silk). This cocoon was formed from below, a small section of a sphere first appearing, the sphere itself taking shape as the work progressed, and being when completed about nine-sixteenths of an inch in diameter. Having but the one cocoon, it was not possible for me to examine the pupa within. When a little later the emergence took place I was pleased to find that the imago was of good size, not having suffered apparently from the long fast in the larval stage.

In the case of the *Chrysopas* (Green Lace-wing Flies), which are near relatives of the ant-lions, we have a tiny spherical cocoon, quite ethereal in appearance and evidently made of silk alone. Before disclosing the imago the pupa of *Chrysopa* neatly cuts for itself a circular door. It then leaves the cocoon entirely and afterwards the disclosure of the imago takes place outside. The pupa of *Myrmeleon formicarius* does not do this, but after making an aperture at the top of the cocoon, protrudes the fore part of its body only, somewhat in the same way as the pupa of the Burnet-moth (*Zygæna trifolii*) does. Emergence of the imago then takes place from a dorsal slit, the delicate pupal skin remaining half-projecting from the orifice in the cocoon.

As previously mentioned interesting changes take place in the mandibles as the ant-lion proceeds from stage to stage of its life-cycle. These I have illustrated by means

of the accompanying figures, which are magnified about 23 times. It will be at once seen how admirably the formidable larval mandibles are formed to serve as a trap to catch the prey in that stage. The pupal jaws are used in the insect's life for a single operation—the cutting of an opening in the cocoon. They are much reduced in size, and the slender hairs are perhaps vestigial only.



Myrmecleon formicarius.

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| 1. Mandibles of Larva | } × abt. 23. |
| 2. Mandibles of Pupa | |
| 3. Mandibles of Imago | |

The sharp points are well adapted for piercing the cocoon and the saw-like edges are equally well suited for enlarging the opening. In the imago the mandibles have become quite simple in form and the hairs have disappeared. Of two species of *Chrysopa* (*C. septempunctata* and *C. clathrata*) whose pupal skins I possess, the jaws in that stage are similar to those of the pupa of *M. formicarius*, and

judging by the clean manner in which *C. clathrata* had opened its cocoon by a circular lid, these jaws must be very efficient instruments for effecting this operation.

[Note on the pupal mandibles by Dr. Chapman.—“ In the three stages of *M. formicarius* the mandibles are of interest to me in connection with the ancestry of the Lepidoptera, in view of the considerations I advanced in Trans. Ent. Soc. 1896, p. 568. No doubt any common *Chrysepa* or *Hemerobius* would afford a similar series, but I am not aware of such a series being figured, certainly not in any English medium I have come across. The pupal jaws are modified so as to be specially suited for opening the cocoon. The pupa throughout its whole existence is absolutely quiescent, and these jaws rest unused. It is when the insect is no longer a pupa, but an imago within the pupal skin, that it becomes active and uses these jaws to open the cocoon. It is not the pupa, but the imago that does this, these pupal jaws being merely a sort of glove to the marginal jaws, now fully developed, but no doubt like the wings requiring a few minutes' adjustment to the new conditions, when the pupal skin has been cast off. Mr. Lucas' specimen shows the pupal skin left in the grip of the opening made in the cocoon, the imago leaving it as soon as the anterior portion is outside the cocoon. It is easy to understand how these pupal jaws are moved by the imago, since it has its own jaws inside them; but how the similar jaws that are used for the same purpose by the *Trichoptera* and the *Eriocraniadae*, which have no imaginal jaws at all, are energised by the imago, remains as difficult to understand as I found it ten years ago.”]

